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SPECIAL ARTICLES

SOME PHYSIOLOGICAL OBSERVATIONS REGARDING
PLUMAGE PATTERNS¹

THIS study was undertaken with the object of carrying the analysis of the genetic factors for color pattern somewhat farther than has hitherto been done. In many forms of domestic poultry the plumage of particular parts of the body displays on each feather a definite and regular pattern. Experimental studies show that these patterns are inherited in a clean-cut Mendelian manner. In the case of the Barred Plymouth Rock color pattern, which has been more thoroughly studied in regard to its inheritance than any other single plumage pattern in birds, extensive investigations in this laboratory and elsewhere indicate that this barred pattern is represented in the gametes by a single Mendelian factor or gene. The manner in which this gene operates physiologically presents a problem of great interest, since it involves an element of morphogenetic localization.

With a view of getting further light on this matter a study has been made of the successive regeneration of feathers, in which special attention has been paid to the comparison of the pattern shown in the regenerates and in the original feather. It is the purpose here to make a preliminary statement regarding this work and some of the results obtained, to be followed later by a detailed account.

A word should be said in regard to one point of technique, since this made possible the carrying on of the investigation in a precise and critical manner. The point referred to is the method used for the identification of the individual feather follicle. If the feathers successively produced in the same follicle are to be compared, it is necessary that this particular follicle shall be capable of absolutely sure identification at any time, whether or not there is a feather present. This result was

very satisfactorily attained by tattooing with india ink a circle around each follicle chosen for study. These tattoo marks are permanent throughout the life of the individual and make it possible to find at any time the follicle which one is studying.

A few of the more important results which have been obtained from this study, which has now been in progress about a year and a half, may be here set forth, as follows:

1. All feather follicles are not capable of continually producing successive feathers for an indefinite time. In the case of the general body plumage a feather is usually not regenerated more than about three times. The precise number of successive regenerations varies with different birds and different feathers. Wing primaries seem to possess the maximum regenerative capacity. After about the third removal in the case of body feathers the follicle usually remains in a perfectly quiescent condition, taking no steps whatever toward the regeneration of a new feather.

2. This failure to regenerate is, however, very definitely related to the natural moult of the bird, and in the following way. A follicle which has been absolutely inactive for a long period of time (*e. g.*, six months) preceding the natural autumn moult of the bird produces a new feather in connection with the moult, in the same manner as does any other follicle of the body. In other words the process of natural moulting reactivates the follicle which had been brought into a quiescent state by successive feather removal.

3. The precise pattern exhibited by a particular feather is, in the usual course of events, reproduced each time a feather is produced by that follicle with extreme fidelity of detail. If, however, the feather is removed from the follicle as soon as it is fully grown, thus forcing continued regenerative activity of the follicle, the pattern tends progressively to be broken up, and probably will ultimately be entirely lost as a definite pattern. The experiments have not yet gone far enough to enable us to speak positively on this latter point. A progressive breaking up of an originally definite pattern is, however, very clearly

¹ Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 60. This paper was read at the meeting of the American Society of Naturalists in Philadelphia, December 31, 1913.

shown in a number of cases.² The behavior of the color pattern in successively regenerated feathers suggests, as a working hypothesis, that the pattern factor or gene is possibly represented in each follicle by a strictly limited amount of material, and that when this is used up the pattern is lost.

4. The secondary sexual feathers of the male, such as the saddle hangers, only appear as adult plumage. The same follicles which bear these feathers produce, as juvenile plumage, undifferentiated body feathers. The formation of these secondary sexual feathers is not necessarily dependent upon any normal moult. If the juvenile feather is removed from the follicle the next feather produced by that follicle will be the secondary sexual feather, and not a feather of the juvenile type. After that all further regenerations are of the sexually differentiated feather.

These investigations are being continued. A complete report, with illustrations, covering the progress of the work to date will shortly be published elsewhere.

RAYMOND PEARL,
ALICE M. BORING

THE AMERICAN SOCIETY FOR PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS

THE fifth annual meeting of the Pharmacological Society was held in Philadelphia on Monday and Tuesday, December 29 and 30, at Jefferson Medical College and the University of Pennsylvania. The scientific meetings were auspiciously inaugurated by a joint session of the three societies which form the Federation of American Societies for Experimental Biology, comprising the Physiological Society, the Society of Biological Chemists and the Pharmacological Society. The program of this joint meeting on Monday morning was opened by a short address of the president of the Physiological Society, Dr. S. J. Meltzer, as chairman of the federation. The title of his address was "Theories of Anesthesia."

The following papers were read and discussed: "Phlorhizin Glycosuria before and after Thyroidectomy," by Graham Lusk.

"Studies in Diabetes: (1) The Effect of Different Compounds of Glycogenesis; (2) The Mech-

² Some of which were shown in the charts used in connection with the reading of this paper.

anism of Antiketogenesis," by A. J. Ringer and E. M. Frankel (by invitation).

"Some Problems of Growth: (a) The Capacity to Grow; (b) The Rôle of Amino Acids in Growth," by L. B. Mendel and T. B. Osborne.

"Further Studies in the Comparative Biochemistry of Purine Metabolism," by Andrew Hunter.

"Changes in Fats during Absorption," by W. R. Bloor.

"Immunization against the Anti-coagulating Effect of Leech Extract," by Leo Loeb. (Read by title.)

"Anaphylaxis in the Cat and Opossum," by C. W. Edmunds.

"Vividiffusion; Report on Preliminary Results," by J. J. Abel, L. S. Rowntree and B. B. Turner.

"A Method of Dialyzing Normal Circulating Blood and Some of Its Applications," by C. L. V. Hess (by invitation) and H. McGuigan.

"A Biological Test for Iodine in the Blood," by A. Woelfel and A. L. Tatum (by invitation).

"Further Studies of the Excretion of Acids," by L. G. Henderson and W. W. Palmer (by invitation).

The second scientific session was also held at Jefferson Medical College on Monday, December 29, from 2 to 5 P.M., and the following papers were read:

"Uranium Glycosuria," by G. B. Wallace and H. B. Meyers.

"A Comparative Study of the Vascular Response of the Kidneys in Animals Nephritic from Uranium Nitrate," by W. deB. MacNider.

"The Production of Glycosuria by Zinc Salts," by W. Salant and M. Kahn.

"Further Observations on Caffeine Glycosuria," by W. Salant and M. Kahn.

"Studies upon the Long-continued Feeding of Saponin," by C. L. Alsberg and C. S. Smith.

"The Effect of the Inhalation of Ether upon the Irritability of the Voluntary Peripheral Motor Mechanism," by J. Auer and S. J. Meltzer.

"The Irritability of Muscle and Motor Nerve in Chloroform Anesthesia," by T. S. Githens and S. J. Meltzer.

"The Cessation of Respiration in Deep Ether Anesthesia and its Possible Relation to the Action of Ether upon the Peripheral Motor Mechanism," by T. S. Githens and S. J. Meltzer.

"The Anesthetic Tensions of Ether Vapor for Man," by W. M. Boothby (by invitation).

"Studies in the Absorption of Drugs," by R. A. Hatcher and Cary Eggleston.